

## Application of Differentiated Learning Through the Use of Interactive Multimedia to Promote Students' Scientific Literacy

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### ABSTRACT (10 PT)

*Scientific literacy skills are an ability needed to face the 21st century. Scientific literacy is defined as the ability to know, complete, convey and apply science in everyday life. Scientific literacy skills make it easy for students to solve issues that occur in real life using scientific methods. The aim of this research is to improve students' scientific literacy skills by utilizing differentiated learning using interactive multimedia. The type of research carried out was classroom action research using the Kemmis and McTaggart model which was carried out in two cycles. Classroom action research consists of 4 stages, namely planning, implementation, observation and reflection. The research was conducted in the research subjects were students in class X.E.1 at SMA Negeri 3 Padang, totaling 36 students. The research results show that there is an increase in students' scientific literacy skills by implementing differentiated learning using interactive multimedia. The application of differentiated learning lies in the content and products presented using interactive multimedia which are based on students' learning readiness and interests.*



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## INTRODUCTION

Scientific literacy is a skill needed by students in the 21st century. Scientific literacy can be defined as the ability to understand, communicate and apply science in life (Yuliati, 2017). Scientific literacy can be defined as scientific knowledge and skills to be able to identify cases, obtain new knowledge, explain scientific phenomena, and draw conclusions based on reality, understand the characteristics of science, explain how science and technology form natural, intellectual and cultural zones, and the willingness to participate and care about issues related to science. Scientific literacy is also defined as the ability to solve problems using scientific processes or scientific attitudes (OECD, 2019; Wahyuningsih, 2021). Scientific literacy is the potential to use scientific knowledge to answer questions and identify existing problems. Scientific literacy skills are not only needed to solve problems related to science. Scientific literacy is also used to connect science with other sciences.

Scientific literacy is considered important for students so that students not only understand science as a concept but can also apply it (Sutrisna, 2021). Weak literacy skills result in difficulties for students to solve problems that occur in the real world (Asrizal & Yulkifli, 2018).

Scientific literacy abilities are divided into context, knowledge, scientific processes and attitudes. The context aspect includes the ability to identify problems that occur and apply science in solving them (Subaidah et al., 2019). The knowledge aspect is an understanding of facts, concepts and explanatory theories that form the basis of scientific knowledge (Firdaus & Asmali, 2021). The process aspect includes the ability to find, process and present the data that has been obtained (Rusilowati et al., 2018). The attitude aspect is interest in science and technology, respect for scientific approaches, use of scientific methods and perception of problems that occur (OECD, 2018).

Based on observations made, it was found that students' scientific abilities were still relatively low. Of the 36 students in the class, only 10% of students have scientific literacy skills in the sufficient category, while the rest are still relatively low. Students have difficulty answering questions that contain literacy because they lack interest in reading and interpreting reading texts. This is also in line with research conducted by Sukowati in 2017 where students' scientific literacy skills were relatively low. This is also in line with research conducted by Masita in 2019 which stated that students' scientific literacy skills were still low, especially in interpreting data. The causes of low scientific literacy include misconceptions, students' lack of interest in reading, non-contextual learning, and the learning environment (Fuadi et al., 2020). Apart from that, low scientific literacy is also caused by a lack of knowledge in applying science in everyday life (Irsan, 2021). Students rarely do practicums and lack of understanding of several terms in the scientific investigation process are also reasons for students' low literacy skills (Sukowati et al., 2017).

Increasing scientific literacy skills requires the teacher's role in creating an interesting learning process that suits the way they learn using teaching materials, interactive multimedia or other learning resources (Fortuna & Fitria, 2021). Increasing scientific literacy skills can be done through a contextual learning process (Asrizal et al., 2018). A contextual learning process requires appropriate learning strategies that suit the characteristics of students. Teachers can adapt learning to students by implementing an independent curriculum in schools. One solution is that teachers can carry out differentiated learning to adapt the learning process to students' abilities (Student & Masa, 2022).

Differentiated learning is a teaching and learning process that is tailored to students' learning readiness, interests and needs in order to avoid failure in learning. Differentiated learning facilitates the diversity of students to be able to achieve learning goals well (Faiz et al., 2022; Tomlinson et al., 2017). Differentiated learning gives teachers the freedom to determine how to manage and implement the learning process appropriately for students. The learning process carried out can be different in each class depending on the differentiated selection by the teacher. So, differentiated learning provides space for students to learn according to their initial desires and abilities.

The application of differentiated learning is divided into process, product, content and learning environment. Process differentiation is differentiation based on learning activities that will be carried out by teachers and students (Wahyuningsari et al., 2022). Teachers can differentiate in providing material based on learning readiness, learning styles and student interests, which is known as content differentiation (Pozas et al., 2021). Product differentiation is providing freedom for students in carrying out tasks or the final demands of the learning process (Purba et al., 2021). The learning environment can be differentiated by providing facilities that support learning according to the needs and interests of students (Fitra et al., 2022). The application of differentiated learning can be adjusted by the teacher

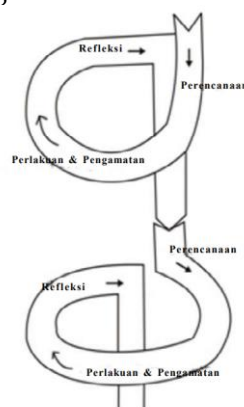
to the needs of students. Teachers can sort and determine the aspects that will be differentiated in the learning that will be carried out. However, the implementation of learning today cannot be separated from technology. Teachers must be able to pair learning resources with the application of technology in the learning process. This aims to make students more motivated to learn.

The use of technology in the learning process can be done by implementing interactive multimedia. Interactive multimedia is a combination of text, audio, video, graphics, animation and interactions that can be controlled by the user in delivering messages (Manurung, 2020). Interactive multimedia can provide a pleasant experience in the learning process and increase students' understanding (Diah et al., 2018). By using interactive multimedia, teachers can carry out content differentiated learning more easily (Nawang Sari et al., 2022). Based on this, the aim of the research is to increase students' scientific literacy using differentiated learning through interactive multimedia.

## METHODS

The research was conducted using a Classroom Action Research (PTK) design with the Kemmis and Mc model. Taggart. Use of the Kemmis and Mc model. Taggart was chosen because there is a reflection of each cycle carried out so that an appropriate learning process is produced to overcome problems in the class. Kemmis and Mc model. Taggart is also known for his spiral model. There are four stages of research using the Kemmis and Mc model. Taggart is planning, implementing, observing and reflecting. This research was conducted on physics learning at SMA Negeri 3 Padang.

Research using the Kemmis and Mc model. Taggart is implemented in 2 cycles (Figure 1). The planning stage begins with planning all the things needed in the learning implementation process. Planning starts from preparing interactive multimedia, teaching modules and preparing students' scientific literacy test sheets on renewable energy material. The expected learning outcomes are that students are able to describe natural phenomena within the scope of process skills in measurement, climate change and global warming, environmental pollution, alternative energy and its use. The second stage is carrying out the learning process using differentiated learning by utilizing interactive multimedia as a learning resource on renewable energy material. The third stage is that observations are carried out simultaneously with the implementation of the learning process. The teacher observes everything that students do in the learning process. Reflection is the final stage carried out after the learning process ends. The results obtained in the learning process are analyzed as an evaluation in the implementation of the first cycle of learning. After reflection, the second cycle of learning continues with the same stages as the first cycle.



**Figure 1.** Kemmis and McTaggart's Action Research Spiral Model (Kemmis et al., 1999)

The research subjects were students at SMA Negeri 3 Padang, especially in class X.E.1. There were 36 students consisting of 24 men and 12 women. Based on data from the school, it was found that the learning styles of X.E.1 students consisted of 5 visual, 25 kinesthetic and 6 audio. The initial abilities of students in class X.E.1 have almost the same level, namely abilities at a medium level. Students have different characteristics. This is what makes the need for varied learning

The data collection technique in this research uses test sheet essay totaling 14 questions. Questions on the test essay describes observations of students' scientific literacy abilities. There are 14 indicators in the scientific literacy assessment (Table 1). The data obtained is in the form of quantitative data from the results of analysis of scientific literacy indicators which are presented in diagram form. The data obtained was then described qualitatively and presented in the form of a descriptive explanation.

Table 1. Aspects of Scientific Literacy based on *Framework PISA*

Aspect	Code	Indicator
<b>Context</b>		
Personal	1	Know the important role of physics knowledge in solving everyday phenomena
Local/National	2	Connecting physics innovation and social processes in responding to physics issues
Global	3	Using an understanding of physics to make decisions related to physics issues
<b>Knowledge</b>		
Content	4	Explain conceptual knowledge
	5	Explain factual knowledge
	6	Explain procedural knowledge
Procedural	7	Able to identify issues to investigate
	8	Formulate a scientific hypothesis
epistemic	9	Using experimental results to explain a phenomenon
<b>Process</b>		
Procedure	10	Observe (observe) the environment
	11	Planning an experiment
	12	Interpret observations
	13	Identify the results of observations
	14	Communicate observation results

(OECD, 2018)

## RESULTS AND DISCUSSION

### Results

In cycle 1, planning is carried out by preparing interactive multimedia that is differentiated in content. Teachers divide students based on students' learning readiness. Students were divided into three groups, namely those who already understood the concept of renewable energy (group 1), those who did not understand (group 2), and the group who were ready to be given a challenge (group 3). Group 1 will be asked by the teacher to solve problems given through interactive multimedia. Groups that did not understand were asked to re-study the renewable energy material provided via video in interactive multimedia. Groups that are ready to be given the challenge are asked to carry out virtual experiments and prove the experimental results.

In cycle 2, the same stages as cycle 1 are carried out. Reflection notes in cycle 1 are improved by providing product differentiation or output from the results of the learning

carried out. Students are given the freedom to reflect on learning outcomes based on their interests. Product differentiation can be in the form of images, videos and simple experimental tools. The results of students' scientific skills in the aspects of content, concepts and processes can be seen in Figure 2.

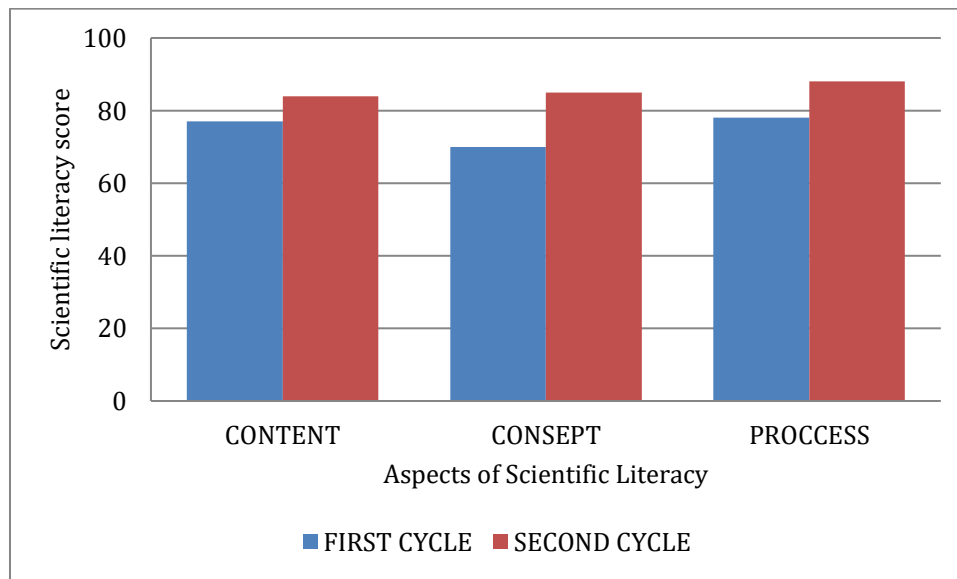


Figure 2. Scientific Literacy Skills

Based on Figure 2, students' scientific literacy skills can be seen from the results of implementing cycles I and II. In cycle I, the scientific literacy results for the students' concept aspect were at 70. The concept aspect got the lowest score in scientific literacy skills. In the process aspect, students get the highest results compared to other aspects, namely 78. This proves that students have great interest and are able to plan the science process. Students do not yet understand the theory but are able to determine the problems faced from the results of observations made.

Observation and reflection activities were carried out by students and class teachers to find out aspects that were weaknesses in the implementation of the learning process in cycle 1. From the results of the observations it was found that students were more enthusiastic about carrying out the learning process and carried out learning according to their readiness. However, students' learning progress can only be seen from the test results essay which is conducted. The expected learning outcomes are not yet clear. This is because there is no product or output provided by students as a result of reflection on the learning that has been carried out. The results of these observations and reflections become notes for improvement in the implementation of the learning process in cycle 2. In cycle 2, differentiated learning is implemented in product aspects so that the results of students' scientific skills in each aspect are improved. The conceptual aspect received the highest increase from a score of 70 to 85.

### Scientific Context Results

The first aspect of scientific literacy skills is context. The context aspect consists of three indicators, namely personal, national and global. In the context aspect, students are expected to be able to understand the important role of physics knowledge in solving everyday phenomena, linking physics innovation and social processes in responding to physics issues and using understanding of physics to make decisions related to physics issues. The results of applying differentiated learning using interactive multimedia for aspects of the scientific context are presented in Table 2.

Table 2. Scientific Context Results

No	Descriptive Statistics Parameters	Cycle 1	Cycle 2
1	The number of students	36	36
2	Average value	77	84
3	Median	76	83
4	Modus	75	80
5	Nilai Minimum	60	80
6	Maximum Value	89	94
7	Range	29	14

Based on Table 2, it can be seen that there is an increase in the average score of students from cycle 1 to cycle 2. In cycle 1 students got an average score of 77, while in cycle 2 it was 84. Students got the highest score of 94 and the lowest score was 80. This shows an increase in students' scientific literacy skills in the context aspect. Students have been able to provide solutions to problems that occur in their environment to global issues. Students are enthusiastic when learning is carried out based on their level of readiness. They don't need to feel embarrassed or left behind by their friends because only they know how to choose to be in a group that suits their learning readiness. Students in cycle 2 got better results than cycle 1 because in cycle 2 the task to check students' understanding was given in a different form according to students' interests. In the context aspect, students are free to look for a problem related to their interests and find a solution from a scientific perspective.

### Results of Scientific Concepts

The second aspect of scientific literacy skills is concepts. The conceptual aspect consists of six indicators, namely the conceptual, procedural and aesthetic sections. In the concept aspect, students are expected to be able to 1) explain conceptual knowledge, 2) explain factual knowledge, 3) explain procedural knowledge, 4) be able to identify problems to be investigated, 5) formulate scientific hypotheses and 6) use experimental results to explain a phenomenon. The results of applying differentiated learning using interactive multimedia for aspects of scientific concepts are presented in Table 3.

Table 3. Scientific Concept Results

No	Descriptive Statistics Parameters	Cycle 1	Cycle 2
1	The number of students	36	36
2	Average value	70	85
3	Median	70	84
4	Modus	60	83
5	Nilai Minimum	58	76
6	Maximum Value	85	95
7	Range	27	19

Scientific literacy skills in the conceptual aspect received the lowest average score in cycle 1. Students had difficulty distinguishing between facts, concepts, laws and principles in the learning carried out. The average score of students in cycle 1 was 70. Students were also less able to determine the correct hypothesis for a given problem due to their lack of interest in reading. Students only read the end of the discourse or problem given. Differentiated learning that is suitable for use is a differentiated process according to students' learning styles. The teacher will provide material in the form of text or images, video and audio. Students can choose the presentation of the material they want. In cycle 2, the teacher makes changes by giving assignments that suit the students' interests and are presented with their respective learning styles in the form of video, audio or a simple tool. The applied differentiated learning using interactive multimedia was able to increase students' scientific literacy skills in the concept section from initially 70 to 85. The increase

that occurred was the highest in terms of process and context aspects. This increase occurs because students can enjoy every learning process carried out.

### Results of the Scientific Process

The third aspect of scientific literacy skills is process. The process aspect consists of five indicators, namely, 1) Observing (observation) the environment, 2) Planning experiments, 3) Interpreting observations, 4) Identifying observation results and 5) Communicating observation results. The results of applying differentiated learning using interactive multimedia for aspects of the scientific process are presented in Table 4.

**Table 4.** Results of the Scientific Process

No	Descriptive Statistics Parameters	Cycle I	Cycle 2
1	The number of students	36	36
2	Average value	78	88
3	Median	78	89
4	Modus	75	85
5	Nilai Minimum	70	80
6	Maximum Value	90	94
7	Reach	20	14

Scientific literacy skills in the process aspect get the highest average score in cycle 1. Students are able to plan research and observe events that occur in their environment. The difficulty for students is in communicating the research results obtained. The average score of students in cycle 1 was 78. Students also had difficulty reading graphs, tables and diagrams presented to complete the experimental results given. The differentiated output learning carried out in cycle 2 provides freedom for students to present the results of their research based on their interests and learning styles. Students can choose to present the results of their experiments using tables, graphs and reports of experimental results. This freedom benefits students because they can do assignments based on what they understand best. To present experimental results that are not yet understood, they can be studied by differentiating the content given in cycle 1. The process aspect in cycle 2 received an average score of 88 from 36 students. The lowest score for students is a score of 80 and the highest is a score of 94. Students are considered to be able to carry out the science process very well.

### Discussion

Based on the results of scientific literacy skills in each aspect with the application of differentiated learning through interactive multimedia, it was found that there was an increase in students' scientific literacy skills. This can happen because the learning process is fun using interactive multimedia. Interactive multimedia increases student activity in the learning process. This is in line with previous research which found that interactive multimedia can increase stimulation for students because its appearance is attractive and not boring (Septian, 2019). The success of interactive multimedia is the interaction between students and multimedia which is obtained from the suitability between multimedia and learning styles (Gunawan et al., 2016). So differentiated learning can be a solution for the diversity of learning styles of students in one class. With differentiated learning, students can learn according to their learning readiness and interests. This has an effect on students' learning motivation. Students no longer feel forced to carry out learning. The tasks given no longer force students to do them because they can choose what kind of tasks to do according to their interests. Research conducted by Pebriyanti (2023), resulted that with differentiated learning, student learning outcomes increased because of the fulfillment of needs and desires in the learning process.

Scientific literacy can increase with a fun learning environment and interactive learning resources. This is because students no longer feel bored when they have to read about the physics phenomena given. Students will feel challenged when carrying out scientific experiments to prove a physics concept. This is proven by previous research which showed that scientific literacy can increase with a fun learning process and learning strategies that focus on direct experience and application of scientific knowledge (Ulfa et al., 2017). Based on research by Sulis (2018), it was found that interactive multimedia makes learning easier and increases motivation so that students can more easily understand the material being taught.

Based on previous research and research that has been conducted, it shows that learning using interactive multimedia presented with differentiated content and products creates a fun learning process. A conducive, fun and interactive learning environment results in an increase in students' scientific literacy skills. Every student can learn according to their learning characteristics. With this, they feel a meaningful learning experience. So, the results of this research can be used as a solution to increase students' scientific literacy and create interactive learning.

## CONCLUSION

The conclusion obtained from this research is that students' scientific literacy can be improved by using interactive learning resources and creating a learning process that is focused on students. One effort that can be made is to utilize differentiated learning using interactive multimedia. Differentiated learning makes the learning process centered on students and interactive multimedia creates learning resources that are not monotonous. This research was carried out on renewable energy materials, so it is hoped that this research can be continued on other physical materials.

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